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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/759,170	01/20/2004	Minh Van Ngo	50432-685	6648
7590 07/28/2004			EXAMINER	
McDermott, Will & Emery 600 13th Street, N.W. Washington, DC 20005-3096			VU, HUNG K	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 07/28/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/759,170

Applicant(s)

NGO ET AL.

Examiner

Hung K. Vu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 12-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 12-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>01/20/04</u> . | 6) <input type="checkbox"/> Other: ____.  |

## **DETAILED ACTION**

### ***Claim Objections***

1. Claim 20 is objected to because of the following informalities: In claim 20, line 1, delete “-rich” for clarity. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 12 – 14, 16 and 18 – 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Han et al. (PN 6,429,129, of record).

Han et al. discloses, as shown in Figures 4 – 6, a semiconductor device comprising,

a dielectric layer (104,106,110) formed over a conductive feature (100) having an upper surface [Col. 3, line 64 – Col. 4, line 4];

an opening in the dielectric layer over the upper surface of the conductive features;

a silicon carbide layer (112) having a silicon surface region lining the opening;

a diffusion barrier layer (114) on the silicon surface region of the silicon carbide layer

and in contact with the upper surface of the conductive feature;

copper (Cu) or Cu alloy (116) filling the opening.

With regard to claim 13, Han et al. discloses the dielectric layer comprises a first dielectric layer (104), a middle etch stop layer (106) on the first dielectric layer and a second dielectric (110) on the middle etch stop layer;

the opening (102) is a dual damascene opening comprising a lower via hole second in the first dielectric layer and an upper trench section in the second dielectric layer.

With regard to claim 14, Han et al. discloses each of the first and second dielectric layers comprises a dielectric material (amorphous fluorocarbon, PTFE, etc.) having a dielectric constant (k) no greater than 3.9 [Col. 22 – 35].

With regard to claims 16 and 19, discloses the thickness of the silicon carbide layer with the silicon surface region is 30Å to 90Å (within the range of 30 to 2000 Å) [Col. 4 lines 36-40].

With regard to claim 18, discloses the barrier layer comprises tantalum, tantalum nitride, or a composite comprising a layer of tantalum nitride on the silicon carbide layer and a layer of tantalum on the layer of tantalum nitride [Col. 4, lines 61-65].

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 17 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. (PN 6,429,129, of record).

Han et al. discloses the invention as claimed including the semiconductor device as recited in the rejection above. Han et al. does not disclose the silicon surface region has a thickness of 10Å to 20Å. Although Han et al. does not teach the thickness of the silicon surface region, as that claimed by Applicants, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the silicon surface region having a desired thickness, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

4. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. (PN 6,429,129, of record) in view of Jin et al. (PN 6,147,407, of record).

Han et al. discloses the invention as claimed including the semiconductor device as recited in the rejection above. Han et al. further discloses each of the first and second dielectric layers comprises amorphous fluorocarbon. Han et al. does not disclose each of the first and second dielectric layers comprises a dielectric material with a porosity of about 10% to about 20%. However, Jin et al. discloses a method of forming each of the first and second dielectric layers (80, 81 and 82,83) comprises a dielectric material (amorphous fluorocarbon) with a porosity of about 10% to about 20% [Figure 8 and Col. 7, lines 10 – 23 of Jin et al.]. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to

form each of the first and second dielectric layers of Han et al. comprising a dielectric material with a porosity of about 10% to about 20%, such as taught by Jin et al. in order to further reduce the dielectric constant of the dielectric layers.

***Conclusion***

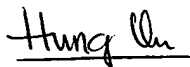
5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hung K. Vu whose telephone number is (571) 272-1666. The examiner can normally be reached on Mon-Thurs 6:00-3:30, alternate Friday 7:00-3:30, Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (571) 272-1732. The Central Fax Number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Vu

July 19, 2004



Hung Vu

Patent Examiner